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Banister et al.

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(45) **Date of Patent: Jun. 19, 2018**

(54) MULTI-THREADED DOWNLOAD WITH ASYNCHRONOUS WRITING

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H04L 29/08	(2006.01)
G06F 17/30	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 67/06*** (2013.01); ***G06F 17/30324*** (2013.01)

(58) **Field of Classification Search**

CPC ... G06F 9/467; G06F 17/30445; G06F 30/477
USPC 709/219; 711/132, 150
See application file for complete search history.

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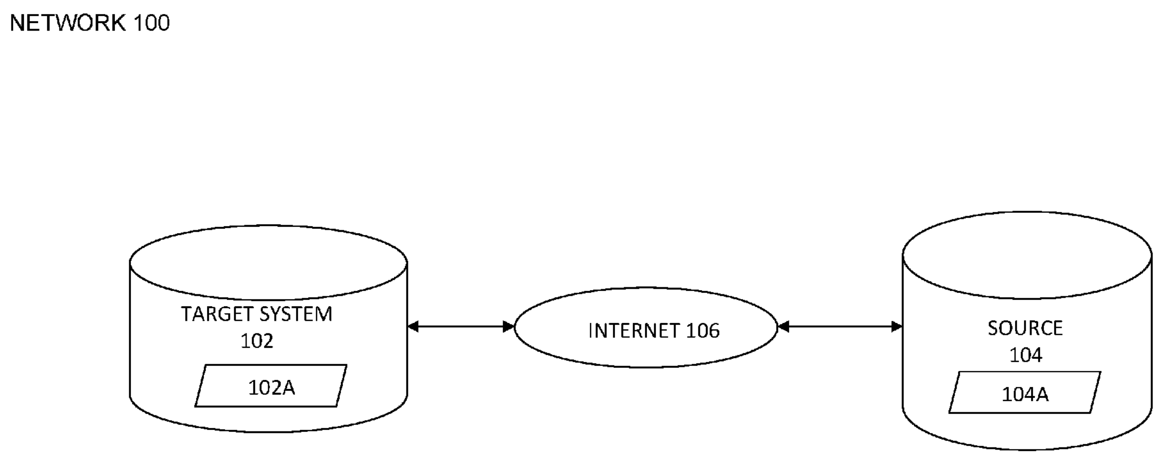
(74) *Attorney, Agent, or Firm* — Patrick Reilly

(57) **ABSTRACT**

A system and method are presented for the facilitation of threaded download of software record identifiers and software records. Software record identifiers and software records are stored in separate one-dimensional stacks, which stacks feed a plurality of download threads in a first-in, first-out method. Software records and/or software record identifiers may optionally be written in parallel, or in an asynchronous manner. The total number of threads allowed to a user may optionally be limited to a pre-set number. The speed and efficiency of downloading records is increased through use of all of the cores of multi-cored computing systems to substantively concurrently download several threads. The method further allows a failed download thread to restart from the point at which it failed, rather than beginning again from the origin of the thread, thus ensuring that no software records are duplicated, and that no software records are skipped within a download thread.

34 Claims, 12 Drawing Sheets



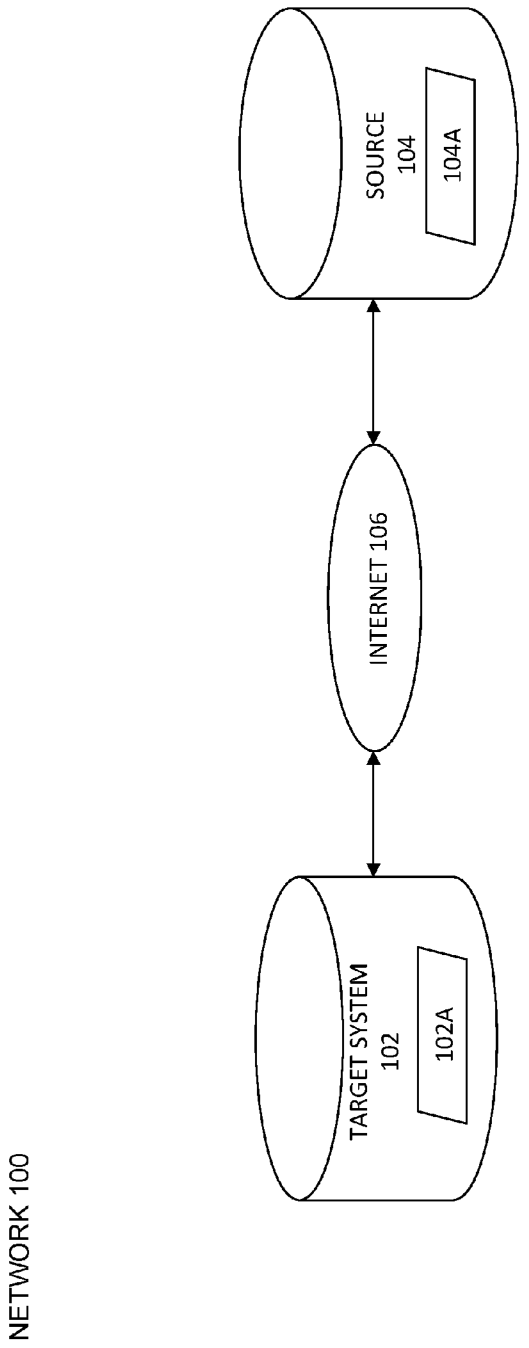

NETWORK 100
TARGET SYSTEM
102
102A
INTERNET 106
SOURCE
104
104A

FIGURE 1

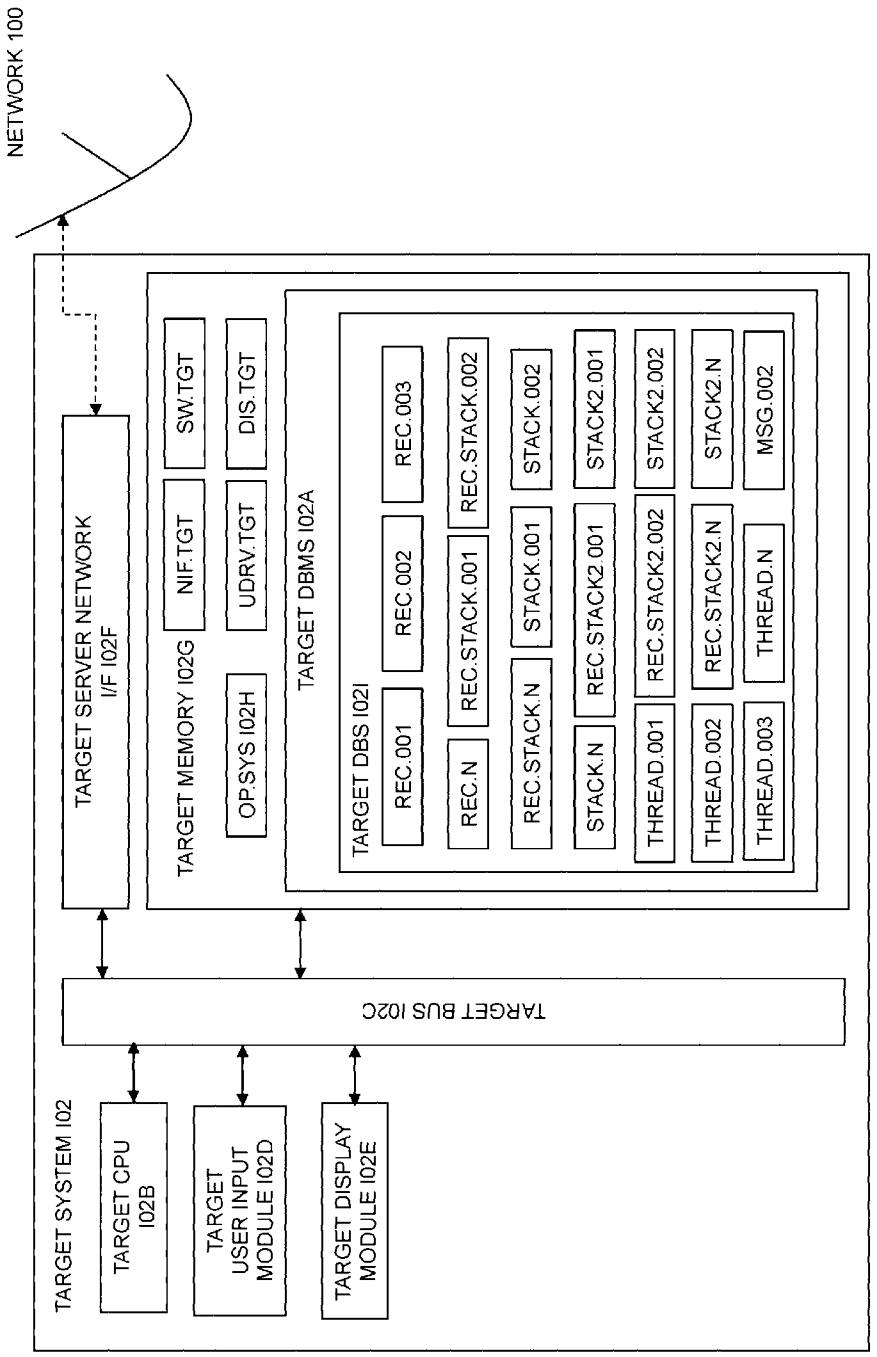

NETWORK 100
TARGET SYSTEM 102
TARGET SERVER NETWORK I/F 102F
TARGET MEMORY 102G
SW.TGT
NIF.TGT
DIS.TGT
UDRV.TGT
OP.SYS 102H
TARGET DBMS 102A
TARGET DBS 102I
REC.001
REC.002
REC.003
REC.N
REC.STACK.001
REC.STACK.002
REC.STACK.N
STACK.001
STACK.002
STACK.N
REC.STACK2.001
STACK2.001
THREAD.001
REC.STACK2.002
STACK2.002
THREAD.002
REC.STACK2.N
STACK2.N
THREAD.003
THREAD.N
MSG.002
TARGET BUS 102C
TARGET CPU 102B
TARGET USER INPUT MODULE 102D
TARGET DISPLAY MODULE 102E

FIGURE 2

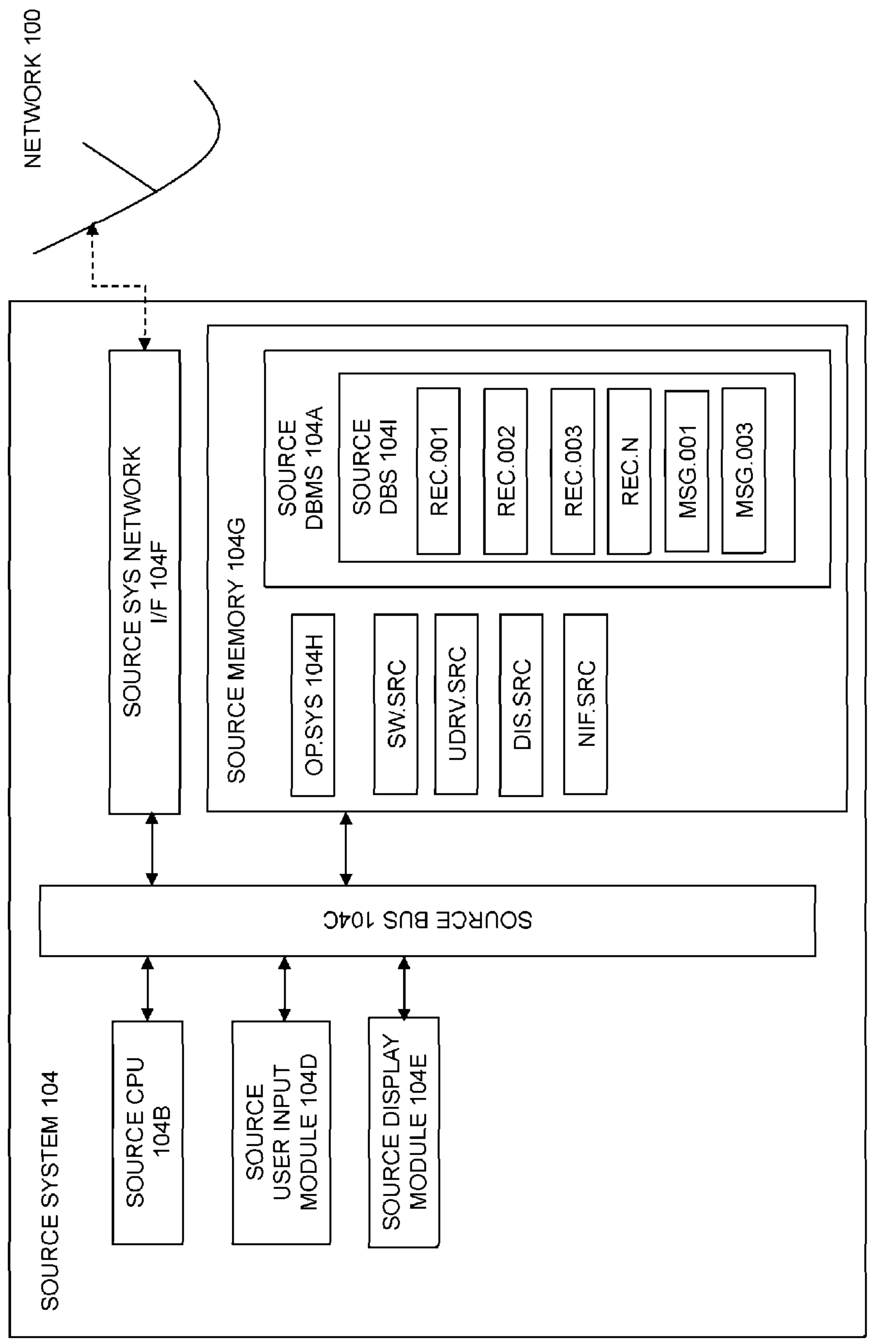

NETWORK 100
SOURCE SYSTEM 104
SOURCE CPU 104B
SOURCE USER INPUT MODULE 104D
SOURCE DISPLAY MODULE 104E
SOURCE BUS 104C
SOURCE SYS NETWORK I/F 104F
SOURCE MEMORY 104G
OP.SYS 104H
SW.SRC
UDRV.SRC
DIS.SRC
NIF.SRC
SOURCE DBMS 104A
SOURCE DBS 104I
REC.001
REC.002
REC.003
REC.N
MSG.001
MSG.003

FIGURE 3

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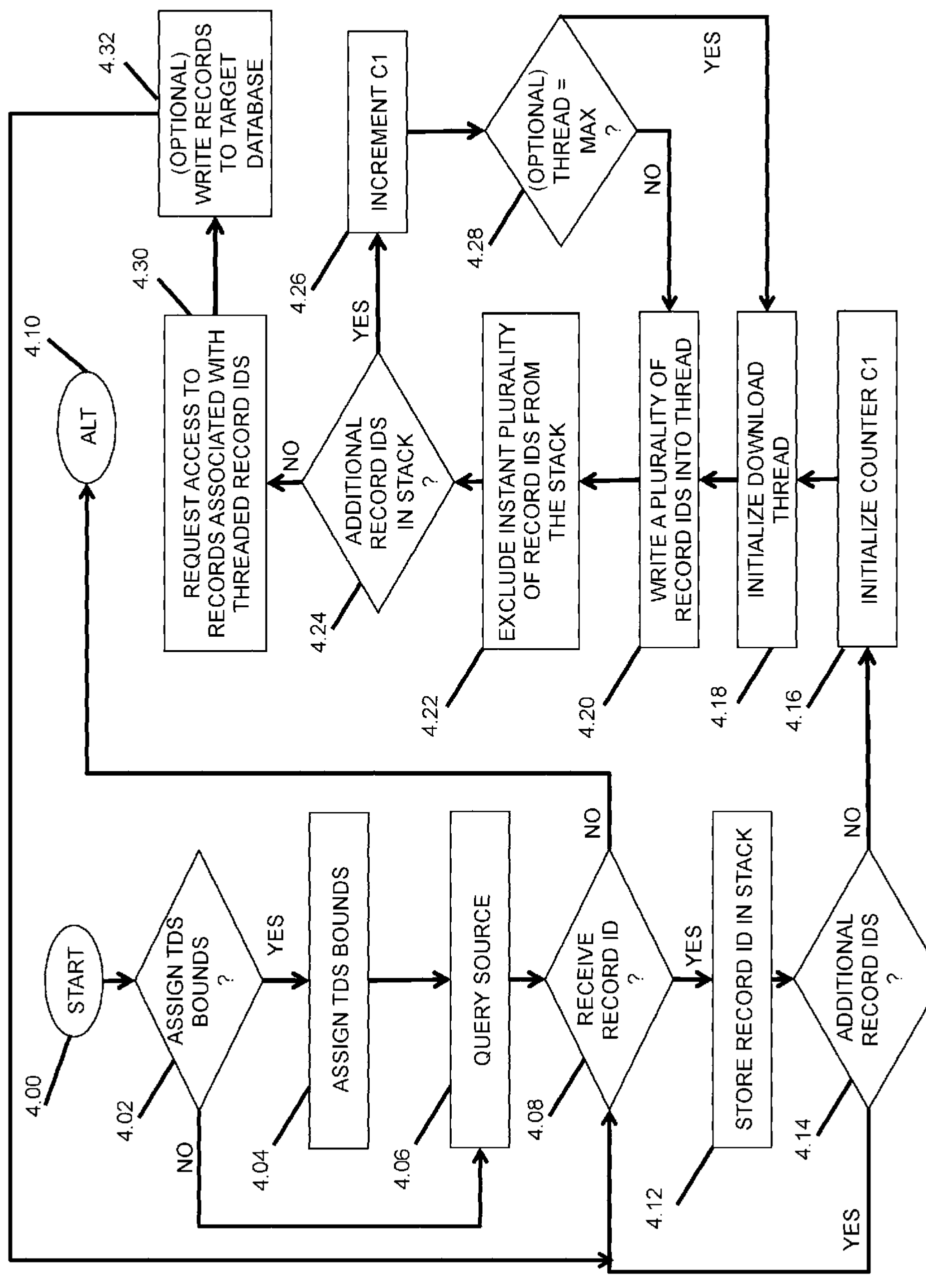

START
4.00
ASSIGN TDS BOUNDS ?
4.02
YES
NO
ASSIGN TDS BOUNDS
4.04
QUERY SOURCE
4.06
RECEIVE RECORD ID ?
4.08
YES
NO
STORE RECORD ID IN STACK
4.12
ADDITIONAL RECORD IDS ?
4.14
YES
NO
ALT
4.10
INITIALIZE COUNTER C1
4.16
INITIALIZE DOWNLOAD THREAD
4.18
WRITE A PLURALITY OF RECORD IDS INTO THREAD
4.20
EXCLUDE INSTANT PLURALITY OF RECORD IDS FROM THE STACK
4.22
ADDITIONAL RECORD IDS IN STACK ?
4.24
YES
NO
REQUEST ACCESS TO RECORDS ASSOCIATED WITH THREADED RECORD IDS
4.30
(OPTIONAL) WRITE RECORDS TO TARGET DATABASE
4.32
INCREMENT C1
4.26
(OPTIONAL) THREAD = MAX ?
4.28
YES
NO

FIGURE 4

TARGET SYSTEM PROCESS

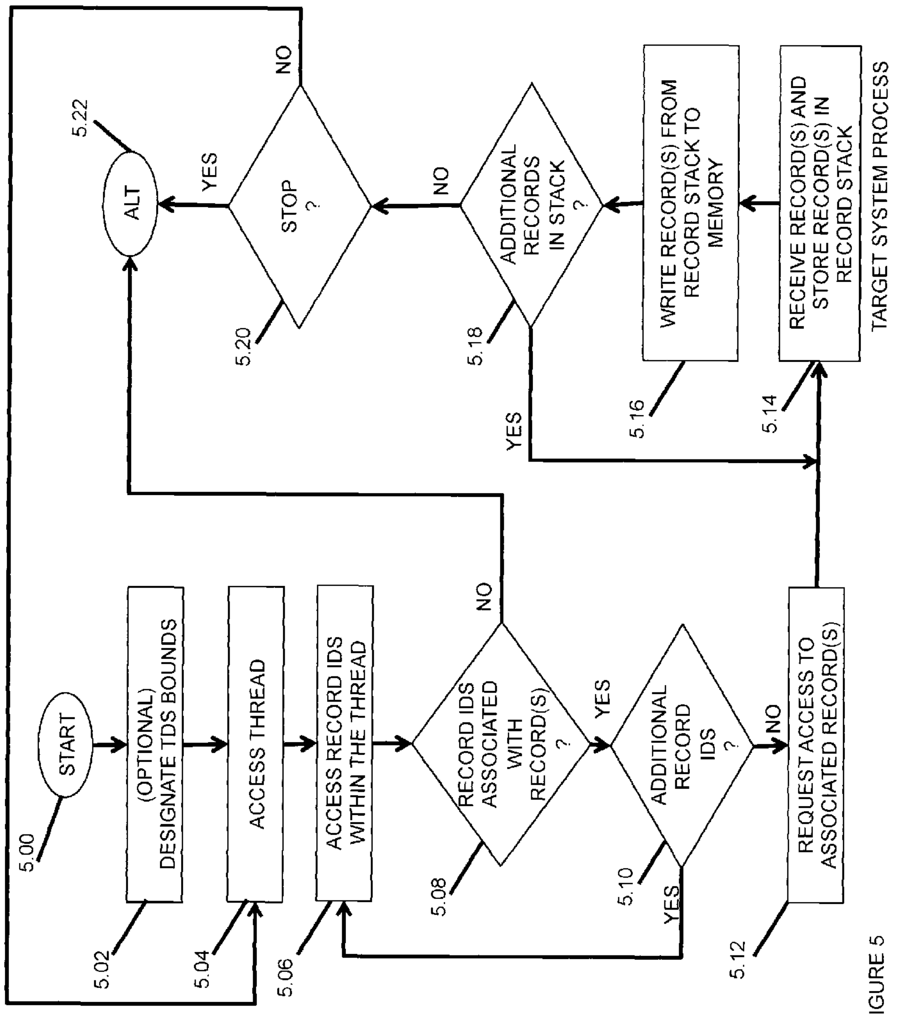
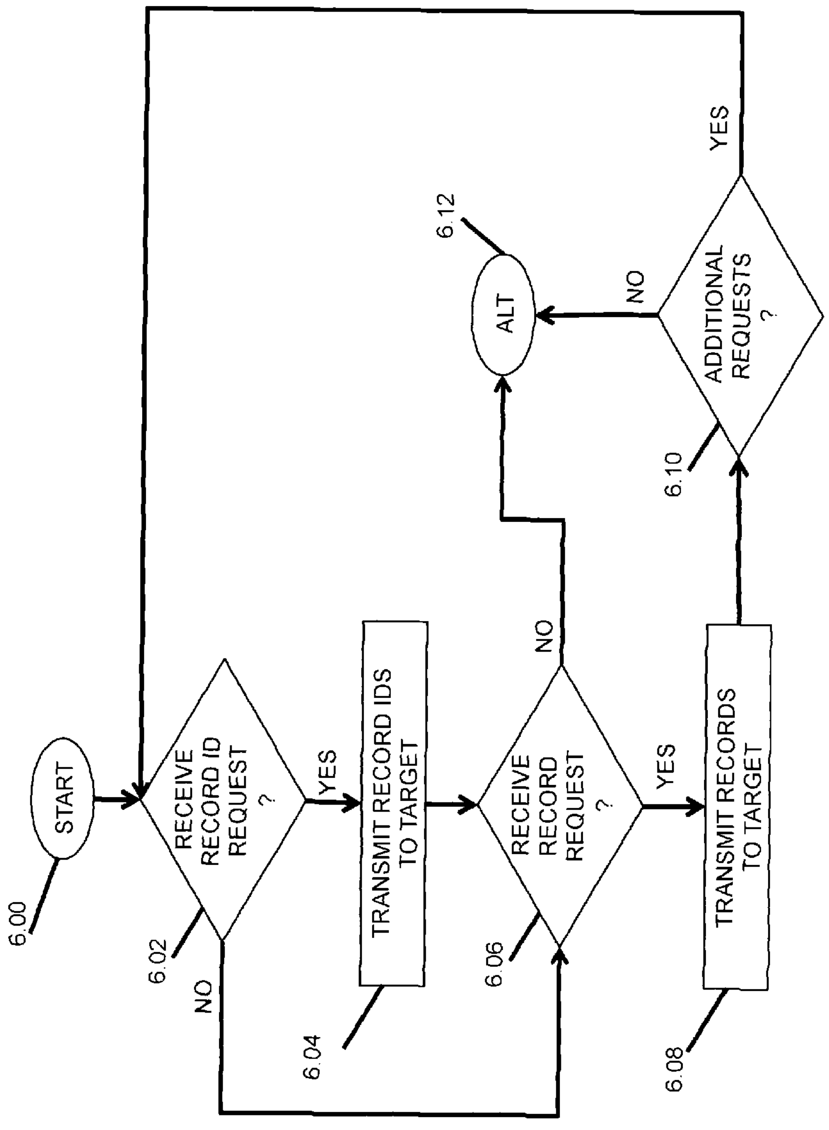

5.00
START
5.02
(OPTIONAL) DESIGNATE TDS BOUNDS
5.04
ACCESS THREAD
5.06
ACCESS RECORD IDS WITHIN THE THREAD
5.08
RECORD IDS ASSOCIATED WITH RECORD(S) ?
NO
YES
5.10
ADDITIONAL RECORD IDS ?
YES
NO
5.12
REQUEST ACCESS TO ASSOCIATED RECORD(S)
5.14
RECEIVE RECORD(S) AND STORE RECORD(S) IN RECORD STACK
5.16
WRITE RECORD(S) FROM RECORD STACK TO MEMORY
5.18
ADDITIONAL RECORDS IN STACK ?
YES
NO
5.20
STOP ?
YES
NO
5.22
ALT
TARGET SYSTEM PROCESS

FIGURE 5



SOURCE SYSTEM PROCESS

FIGURE 6

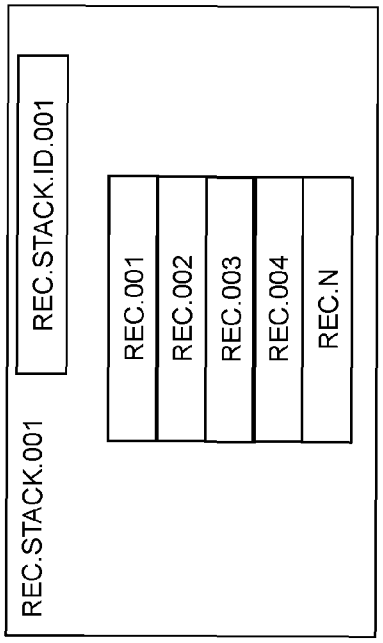


FIGURE 7A

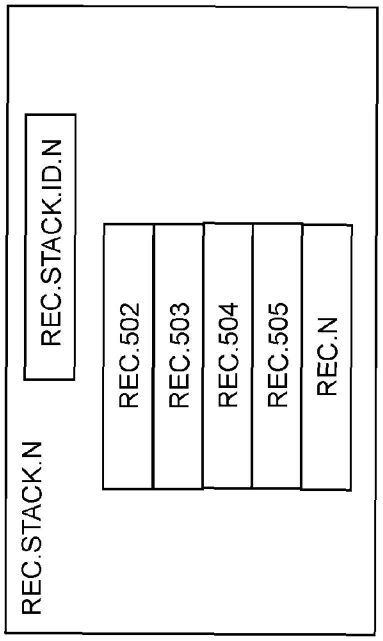


FIGURE 7B

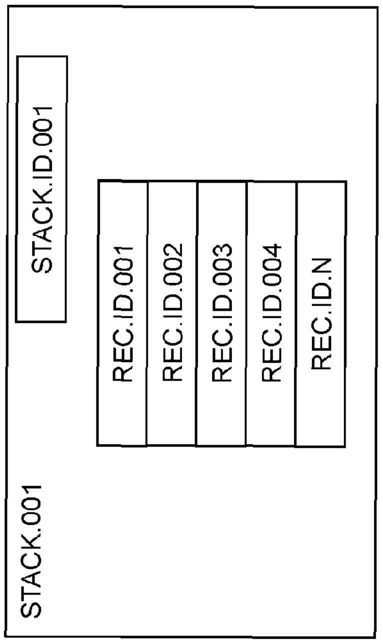


FIGURE 7C

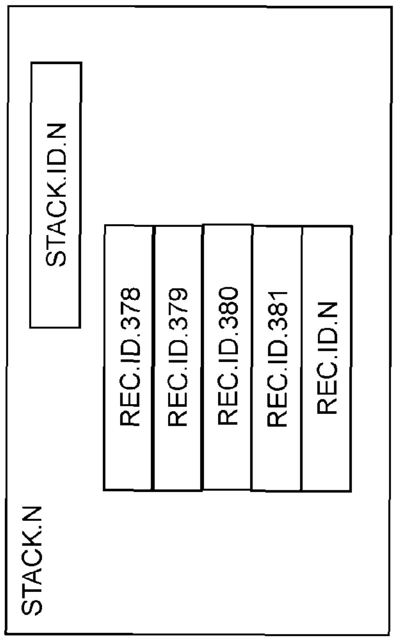


FIGURE 7D

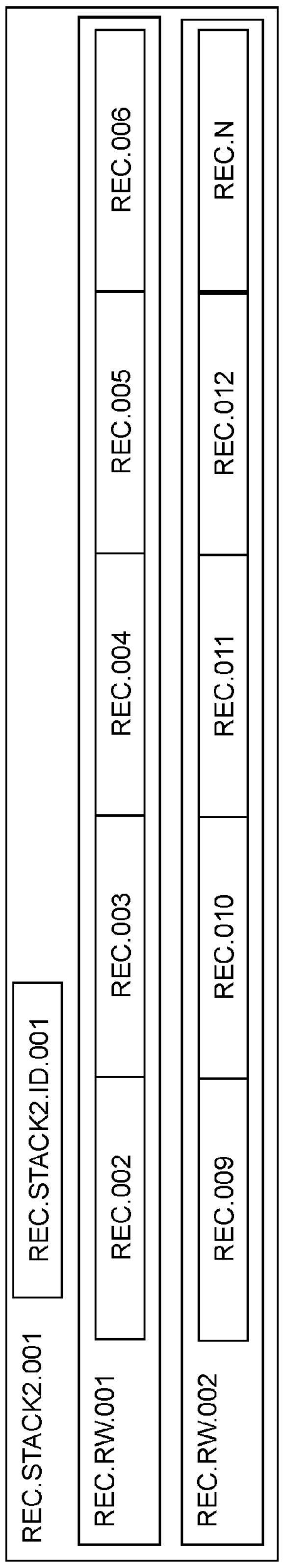


FIGURE 7E

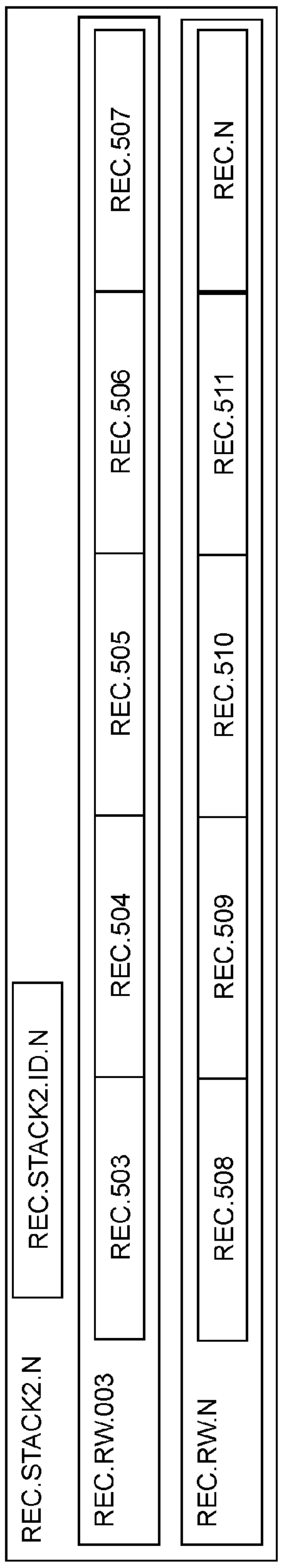


FIGURE 7F

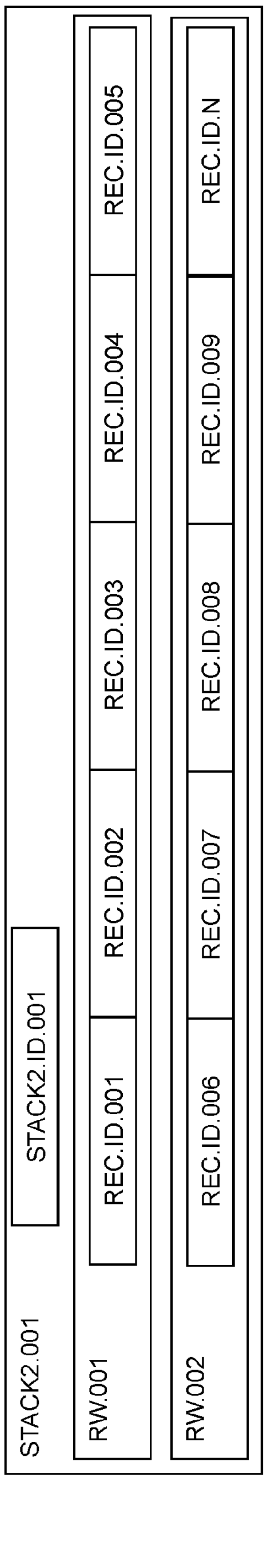


FIGURE 7G

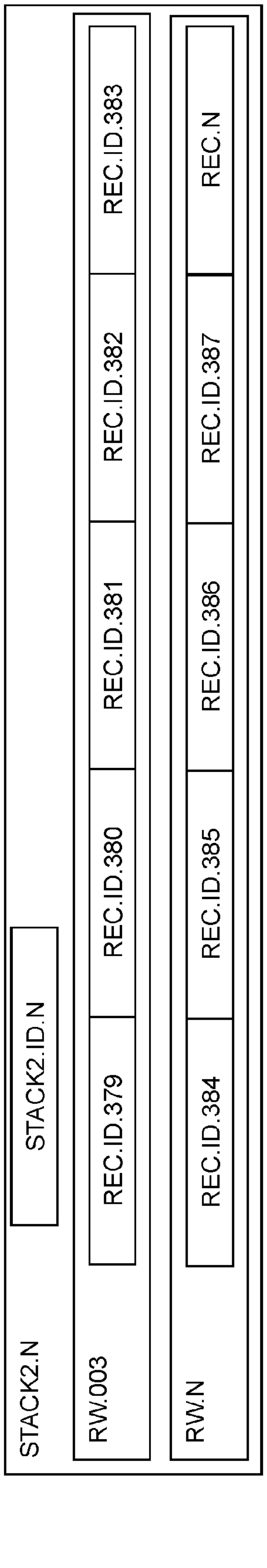


FIGURE 7H

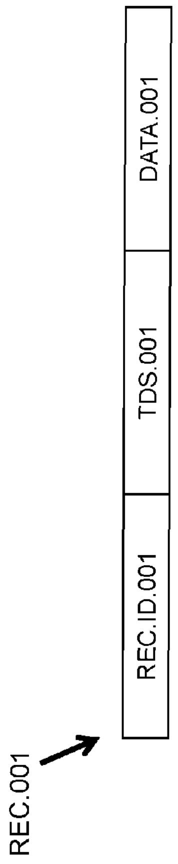


FIGURE 8A

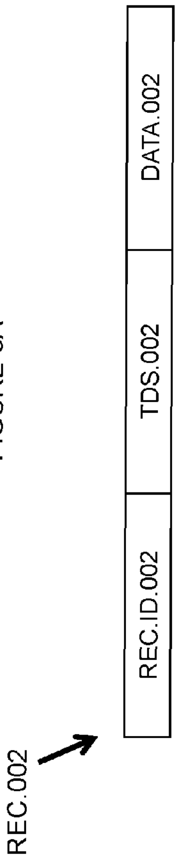


FIGURE 8B

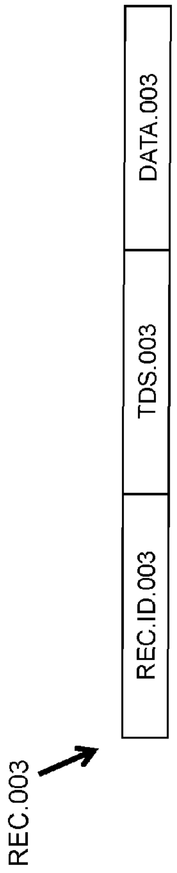


FIGURE 8C

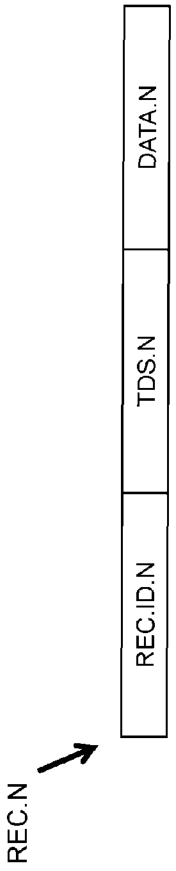


FIGURE 8D

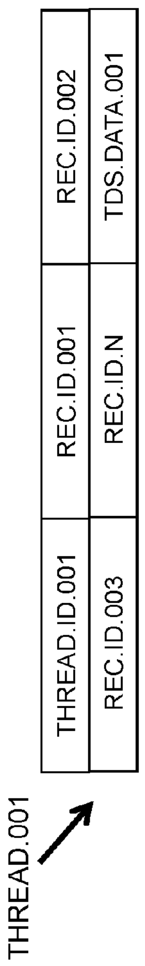


FIGURE 9A

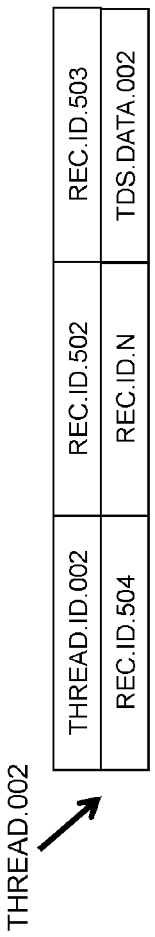


FIGURE 9B

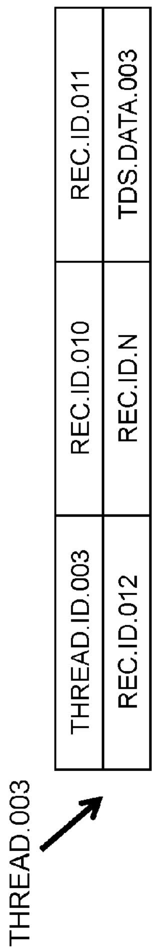


FIGURE 9C

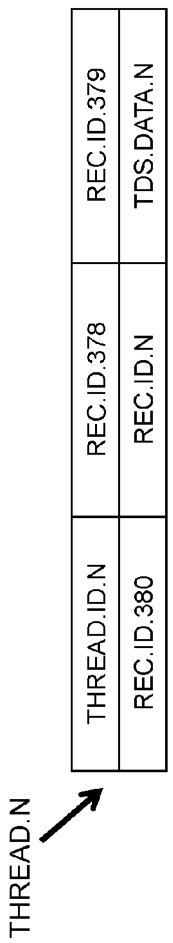


FIGURE 9D

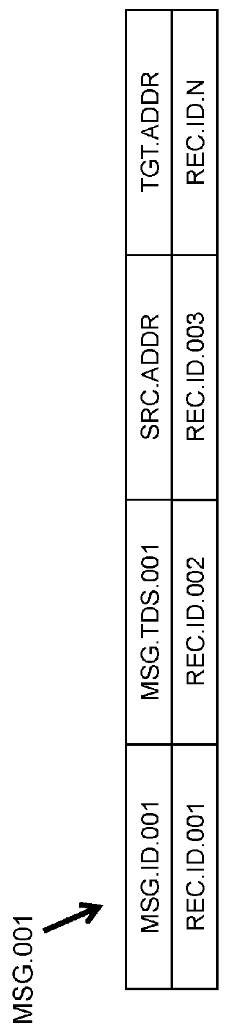


FIGURE 10A
MESSAGE: SOURCE SYSTEM TO TARGET SYSTEM

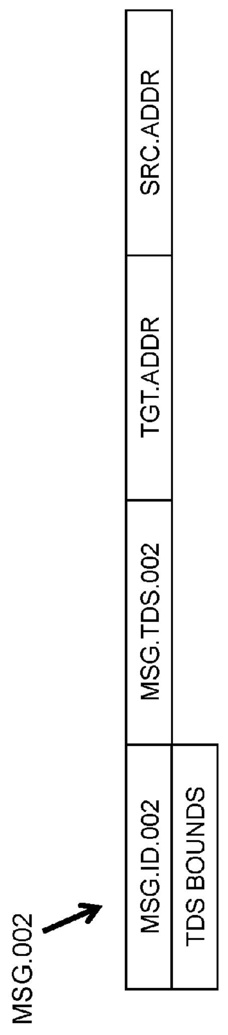


FIGURE 10B
MESSAGE: TARGET SYSTEM TO SOURCE SYSTEM

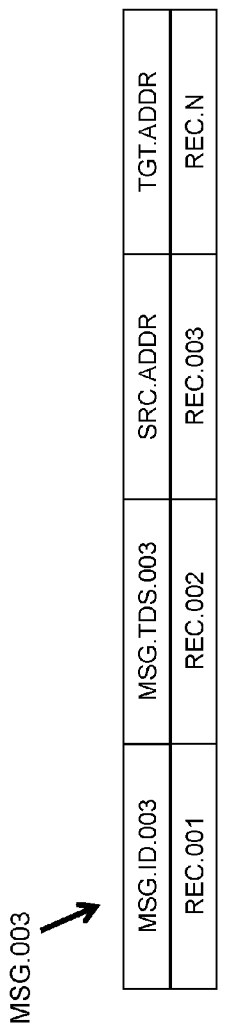


FIGURE 10C
MESSAGE: SOURCE SYSTEM TO TARGET SYSTEM

MULTI-THREADED DOWNLOAD WITH ASYNCHRONOUS WRITING

FIELD OF THE INVENTION

The present invention relates to a process for the maintenance and update of digitized records. More particularly the present invention relates to a method by which records and record identifiers may be accessed in threaded downloads via an electronic communications network.

BACKGROUND OF THE INVENTION

The subject matter discussed in the background section should not be assumed to be prior art merely as a result of its mention in the background section. Similarly, a problem mentioned in the background section or associated with the subject matter of the background section should not be assumed to have been previously recognized in the prior art. The subject matter in the background section merely represents different approaches, which in and of themselves may also be inventions.

The prior art enables the transfer of large amounts of data across the Internet between databases. The prior art fails, however, to provide optimal systems and methods by which the data may be transferred. Improvements on existing prior art methods for access and transfer processes for data record identifiers and data records is desirable across large sectors of user groups.

There is therefore a long-felt need to provide a method and system that provide increased efficiencies of electronic transfers of data and transfer processes of data and data records.

SUMMARY AND OBJECTS OF THE INVENTION

Towards these objects and other objects that will be made obvious in light of the present disclosure, a system and method are provided to enable the electronic transfer of software records by means of a plurality of download threads.

In a first preferred embodiment of the method of the present invention (hereinafter “the invented method”), a target computing system gains access to a plurality of software record identifiers, and writes the plurality of software record identifiers to a one-dimensional digital stack. A first plurality of record identifiers are subsequently written into a first download thread, and preferably deleted from the digital stack, upon completion of the write from the digital stack to the first download thread. A plurality of software records associated with the first plurality of software record identifiers may subsequently be accessed by means of the first thread. Additionally, the invented method may preferably include newly accessed software record identifiers being written asynchronously, while record identifiers are concurrently being written to a plurality of threads.

In a further preferred embodiment of the invented method, a target computer system accesses a plurality of software record identifiers by means of a first download thread. The plurality of software record identifiers is preferably associated with at least one software record, whereby the software record may be retrieved by means of its associated software record identifier within the download thread. The associated software records may subsequently be stored in a one-

dimensional digital record stack, and may be written from the digital record stack into the memory of the target computing system.

The present invention further includes a computing system by which a plurality of software record identifiers may be accessed and means by which the plurality of software record identifiers may be stored in a one-dimensional digital stack. The computing system also preferably comprises means to write the first plurality of record identifiers into the first thread from the one-dimensional digital stack, and means by which the written first plurality of record identifiers may be deleted from the digital stack. The computing system further includes means by which the software records associated with the software record identifiers in the thread may be accessed.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE FIGURES

These, and further features of the invention, may be better understood with reference to the accompanying specification and drawings depicting the preferred embodiment, in which:

FIG. **1** is a diagram of a network, wherein the network includes a target computing system and a source computing system, bidirectionally communicatively coupled by means of one or more network coupling means known in the art, including but not limited to the Internet;

FIG. **2** is a block diagram of the target computing system;

FIG. **3** is a block diagram of the source computing system;

FIG. **4** is a flowchart of an aspect of the invented method whereby the target system accesses record identifiers, assigns the record identifiers to threads, and accesses software records;

FIG. **5** is a flowchart of an aspect of the invented method whereby the target system accesses record identifiers from threads, accesses a plurality of software records associated with the record identifiers, and writes the records associated with the record identifiers into a record stack in the memory of the target computing system;

FIG. **6** is a flowchart of an aspect of the invented method whereby the source system is queried and accessed for record identifiers and records;

FIGS. **7**A-**7**H are block diagrams of a first through an Nth exemplary one-dimensional record stack, first through Nth exemplary one-dimensional stack, first through Nth two-dimensional record stack, and first through Nth two-dimensional stack;

FIGS. **8**A-**8**D are block diagrams of a first through an Nth exemplary software record;

FIGS. **9**A-**9**D are block diagrams of a first through an Nth exemplary thread; and

FIGS. **10**A-**10**C are block diagrams of exemplary messages transmitted between the target system and the source system.

DETAILED DESCRIPTION

Referring now generally to the Figures, and particularly to FIG. **1**, FIG. **1** is a diagram of an electronic communications network **100**, wherein the electronic communications network **100** includes a target system **102** and a source system

104, bidirectionally communicatively coupled by means of one or more network coupling means known in the art, including but not limited to the Internet **106**. The electronic communications network **100** bi-directionally communicatively couples, wherein the bidirectional communicative coupling may be accomplished via the Internet **106** and/or other suitable communications structures, equipment and systems known in the art. The source server **104**, and the target system **102**, each preferably comprise, or are bi-directionally communicatively coupled with, a separate database management system software, respectively a source DBMS **104**A and a target DBMS **102**A.

The source DBMS **104**A and/or the target DBMS **102**A may be or comprise an object oriented database management system ("OODBMS"), a relational database management system ("RDBMS") and/or an NoSQL database management system, and one or more databases, DBS **104**I, and/or DBS **102**I, may be or comprise an object oriented database, a relational database and/or an NoSQL database. More particularly, the target database DBMS **102**A and/or the source database DBMS **104**A may be or comprise one or more prior art database management systems including, but not limited to, an ORACLE DATABASE™ database management system marketed by Oracle Corporation, of Redwood City, Calif.; a Database 2™, also known as DB2™, relational database management system as marketed by IBM Corporation of Armonk, N.Y.; a Microsoft SQL Server™ relational database management system as marketed by Microsoft Corporation of Redmond, Wash.; MySQL™ as marketed by Oracle Corporation of Redwood City, Calif.; and a MONGODB™ as marketed by MongoDB, Inc. of New York City, USA; the POSTGRESQL™ open source object-relational database management system; and/or a NoSQL database.

It is understood that the scope of meaning of the term "NoSQL" as defined within the present disclosure includes a class of database management systems that do not follow all of the rules of a relational database management system and might not use traditional structured query language (hereinafter, "SQL") to query data. This type of database is generally a complementary addition to relational database management systems and SQL. Some notable implementations of NoSQL are the CASSANDRA DATABASE™, marketed by Facebook, Inc., of Menlo Park, Calif.; BIGTABLE™ marketed by Google, Inc., of Mountain View, Calif.; and SIMPLEDB™, marketed by Amazon.com, Inc., of Seattle, Wash.

A NoSQL database does not necessarily follow the strict rules that govern transactions in relational databases. These violated rules are Atomicity, Consistency, Integrity, Durability. For example, NoSQL databases do not use fixed schema structures and SQL joins.

The source server **104** may bi-directionally communicate and transfer data with the target system **102** via the network **100** by suitable electronic communications messaging protocols and methods known in the art including, but not limited to, Simple Object Access Protocol, Representational State Transfer, and/or a web service adapted to conform with the architecture and structure of the World Wide Web.

It is understood that the source server **104** comprises a source system software program SW.SRC comprised within, hosted by and/or enabled by a bundled computer software and hardware product, such as, but not limited to, a.) a network-communications enabled THINKSTATION WORKSTATION™ notebook computer marketed by Lenovo, Inc. of Morrisville, N.C.; (b.) a NIVEUS 5200 computer workstation marketed by Penguin Computing of

Fremont, Calif. and running a LINUX™ operating system or a UNIX™ operating system; (c.) a network-communications enabled personal computer configured for running WINDOWS XP™, or WINDOWS 8™ operating system marketed by Microsoft Corporation of Redmond, Wash.; or (d.) other suitable computational system or electronic communications device known in the art capable of providing or enabling a electronic communications and database management operations known in the art.

It is understood that the target system **102** also comprises a local system software program SW.TGT comprised within, hosted by and/or enabled by a bundled computer software and hardware product, such as, but not limited to, a.) a network-communications enabled THINKSTATION WORKSTATION™ notebook computer marketed by Lenovo, Inc. of Morrisville, N.C.; (b.) a NIVEUS 5200 computer workstation marketed by Penguin Computing of Fremont, Calif. and running a LINUX™ operating system or a UNIX™ operating system; (c.) a network-communications enabled personal computer configured for running WINDOWS XP™, or WINDOWS 8™ operating system marketed by Microsoft Corporation of Redmond, Wash.; or (d.) other suitable computational system or electronic communications device known in the art capable of providing or enabling a electronic communications and database management operations known in the art.

Referring now generally to the Figures, and particularly to FIG. **2**, FIG. **2** is a block diagram of the target system **102** of the electronic communications network **100** of FIG. **1**, wherein the target system **102** may comprise: a central processing unit ("CPU") **102**B; a user input module **102**D; a display module **102**E; a software bus **102**C bi-directionally communicatively coupled with the CPU **102**B, the user input module **102**D, the display module **102**E; the software bus **102**C is further bi-directionally coupled with a network interface **102**F, enabling communication with alternate computing devices by means of the electronic communications network **100**; and a memory **102**G. The target software bus **102**C facilitates communications between the above-mentioned components of the target system **102**.

The memory **102**G of the target system **102** includes a target software operating system OP.SYS **102**H. The target software OP.SYS **102**H of the target system **102** may be selected from freely available, open source and/or commercially available operating system software, to include but not limited to a LINUX™ or UNIX™ or derivative operating system, such as the DEBIAN™ operating system software as provided by Software in the Public Interest, Inc. of Indianapolis, Ind.; a WINDOWS XP™, or WINDOWS 8™ operating system as marketed by Microsoft Corporation of Redmond, Wash.; or the MAC OS X operating system or iPhone G4 OS™ as marketed by Apple, Inc. of Cupertino, Calif. The target memory **102**G further includes the target system software program SW.TGT, a target user input driver UDRV.TGT, a target display driver DIS.TGT, and a target network interface drive NIF.TGT. Within the target DBMS **102**A hosted by the target system **102** is a target database **1201**, wherein are optionally contained (a.) a plurality of exemplary software records REC.**001**, REC.**002**, REC.**003**, and REC.N; (b.) a plurality of exemplary one-dimensional record stacks REC.STACK.**001**. REC.STACK.**002**, and REC.STACK.N; (c.) a plurality of exemplary one-dimensional stacks STACK.**001**, STACK.**002**, and STACK.N; (d.) a plurality of exemplary two-dimensional record stacks REC.STACK**2**.**001**, REC.STACK**2**.**002**, and REC.STACK**2**.N; (e.) a plurality of exemplary two-dimensional stacks STACK**2**.**001**, STACK**2**.**002**, and STACK**2**.N;

(f) a plurality of exemplary download threads THREAD.**001**-THREAD.N; and (g.) an exemplary second message MSG.**002** to be transmitted from the target system **102** to the source system **104**.

The exemplary target system software program SW.TGT is optionally adapted to enable the target system **102** to (a.) generate messages and communicate with the source server **104**, (b.) process communications with and process messages received from the source server **104**, and (c.) manage the target DBMS **102**A to perform, execute and instantiate all elements, aspects and steps as required of the target system **102** to practice the invented method in its various preferred embodiments as particularly outlined in the methods described in FIGS. **1** and **2**, and accompanying text in conjunction with one or more of the components described in FIGS. **7**A through **10**C, and to interact with the source server **104**.

Referring now generally to the Figures, and particularly to FIG. **3**, FIG. **3** is a block diagram of the source system **104** of the electronic communications network **100** of FIG. **1**, wherein the source server **104** comprises: a central processing unit ("CPU") **104**B; a user input module **104**D; a display module **104**E; a software bus **104**C bi-directionally communicatively coupled with the CPU **104**B, the user input module **104**D, the display module **104**E; the software bus **104**C is further bi-directionally coupled with a network interface **104**F, enabling communication with alternate computing devices by means of the electronic communications network **100**; and a source memory **104**G. The source software bus **104**C facilitates communications between the above-mentioned components of the source server **104**.

The memory **104**G of the source server **104** includes a source software operating system OP.SYS **104**H. The source software OP.SYS **104**H of the source server **104** may be selected from freely available, open source and/or commercially available operating system software, to include but not limited to a LINUX™ or UNIX™ or derivative operating system, such as the DEBIAN™ operating system software as provided by Software in the Public Interest, Inc. of Indianapolis, Ind.; a WINDOWS XP™, or WINDOWS 8™ operating system as marketed by Microsoft Corporation of Redmond, Wash.; or the MAC OS X operating system or iPhone G4 OS™ as marketed by Apple, Inc. of Cupertino, Calif. The source memory **104**G further includes the source system software program SW. SRC, a source user input driver UDRV.SRC, a source display driver DIS.SRC, and a source network interface drive NIF.SRC. Within a source database management system **104**A (hereinafter "DBMS **104**A") is a source database **104**I (hereinafter "source DBS **104**I"). The source DBS **104**I contains a plurality of software records REC.**001**, REC.**002**, REC.**003**, and REC.N, an exemplary first message MSG.**001** to be transmitted from the source system **104** to the target system **102**, and an exemplary third message MSG.**003** to be transmitted from the source system **104** to the target system **102**.

The exemplary source system software program SW.SRC is optionally adapted to enable the source server **104** to (a.) generate messages and communicate with the target system **102**, (b.) process communicate with and process messages received from the target system **102**, and (c.) manage the source DBMS **104**A to perform, execute and instantiate all elements, aspects and steps as required of the source server **104** to practice the invented method in its various preferred embodiments particularly as outlined in the method of FIG. **6**, and accompanying text, in conjunction with one or more of the components described in FIGS. **7**A through **10**C, including interactions with the target system **102**.

Referring now generally to the Figures, and particularly to FIG. **4**, FIG. **4** is a flowchart of an aspect of the invented method whereby the target system **102** accesses record identifiers REC.ID.**001**-REC.ID.N, assigns the record identifiers REC.ID.**001**-REC.ID.N to threads THREAD.**001**-THREAD.N, and accesses software records REC.**001**-REC.N. In step **4.02** the target system **102** determines whether to assign one or more time date stamp boundaries TDS.**001**-TDS.N to a query sent to the source system **104**. When the target system **102** determines in step **4.02** to assign one or more time date stamp boundaries TDS.**001**-TDS.N to a query sent to the source system **104**, the time date stamp boundaries TDS.**001**-TDS.N are assigned to the query in step **4.04**. Alternatively, when the target system determines, in step **4.02**, not to assign one or more time date stamp boundaries TDS.**001**-TDS.N to a query sent to the source system **104**, the target system **102** proceeds to step **4.06**, wherein the target system **102** transmits a query MSG.**002** for software record identifiers REC.ID.**001**-REC.ID.N, optionally but not necessarily bound by the one or more time date stamp boundaries TDS.**001**-TDS.N assigned above, to the source system **104**. In step **4.08** the target system **102** determines whether one or more record identifiers REC.ID.**001**-REC.ID.N have been received from the source system **104** by means of a record-identifier-containing message MSG.**001**. When the target system **102** determines in step **4.08** that one or more record identifiers REC.ID.**001**-REC.ID.N have not been received from the source system **104**, the target system **102** proceeds to step **4.10**, wherein alternate processes are executed.

In the alternative, when the target system **102** determines in step **4.08** that one or more record identifiers REC.ID.**001**-REC.ID.N have been received from the source system **104**, the target system **102** stores the received record identifiers REC.ID.**001**-REC.ID.N in a one-dimensional stack STACK.**001**-STACK.N, or in a row RW.**001**-RW.N of a two-dimensional stack STACK**2**.**001**-STACK**2**.N in step **4.12**. In step **4.14** the target system **102** determines whether additional record identifiers REC.ID.**001**-REC.ID.N are present which may be stored in the one-dimensional stack STACK.**001**-STACK.N. When the target system **102** determines in step **4.12** that additional record identifiers REC.ID.**001**-REC.ID.N are present or received from the source system **104**, the target system **102** returns to step **4.08**, and completes the loop of steps **4.08** through **4.12** until a positive determination is reached in step **4.12**. When the target system **102** finds that no additional record identifiers REC.ID.**001**-REC.ID.N are present to be stored in the one-dimensional stack STACK.**001**-STACK.N, the target system proceeds to step **4.16**. In step **4.16**, a first counter C1 is initialized, for the purpose counting the number and/or volume of record identifiers REC.ID.**001**-REC.ID.N assigned to one or more download threads THREAD.**001**-THREAD.N. The maximum number of record identifiers REC.ID.**001**-REC.ID.N which may be assigned to the one or more download threads may optionally be determined by a previously designated thread count value Tcv.

In step **4.18** a download thread THREAD.**001**-THREAD.N is initialized by the target system **102**. The initialization of the download thread THREAD.**001**-THREAD.N may be triggered by one or more occurrences within the target system **102**, and may more particularly be triggered by the achievement of a previously designated plurality of record identifiers REC.ID.**001**-REC.ID.N are stored within the one-dimensional stack STACK.**001**-STACK.N. In step **4.20** a first plurality of record identifiers REC.ID.**001**-REC.ID.N are written into the download thread THREAD.**001**-THREAD.N; the first plurality of record identifiers REC.ID.**001**-REC.ID.N may optionally be written to the download thread THREAD.**001**-THREAD.N in a synchronous manner, or may optionally and preferably be written into the download thread THREAD.**001**-THREAD.N asynchronously. In step **4.22** the plurality of record identifiers REC.ID.**001**-REC.ID.N which have been written to the download thread THREAD.**001**-THREAD.N are excluded from the one-dimensional stack STACK.**001**-STACK.N, optionally and preferably by means of overwriting of memory locations within the target memory **102**G of the target system **102**. The target system **102** subsequently proceeds to step **4.24**, wherein the target system **102** determines whether additional record identifiers REC.ID.**001**-REC.ID.N are present within the stack STACK.**001**-STACK.N which may be written to the instant download thread THREAD.**001**-THREAD.N. When the target system **102** determines in step **4.24** that additional record identifiers REC.ID.**001**-REC.ID.N are present within the stack STACK.**001**-STACK.N which may be written to the instant download thread THREAD.**001**-THREAD.N, the target system **102** proceeds to step **4.26**, wherein the target system **102** increments the first counter C**1**. In optional step **4.28** the target system **102** optionally determines whether the instant thread THREAD.**001**-THREAD.N has reached a previously determined maximum number of record identifiers REC.ID.**001**-REC.ID.N. When the target system **102** determines in step **4.28** that instant thread THREAD.**001**-THREAD.N has reached a previously determined maximum number of record identifiers REC.ID.**001**-REC.ID.N, the target system **102** proceeds to step **4.18**, wherein a new download thread THREAD.**001**-THREAD.N is initialized. Alternatively, when the target system **102** determines in step **4.28** that the instant download thread THREAD.**001**-THREAD.N has not reached a previously determined maximum number of record identifiers REC.ID.**001**-REC.ID.N, the target system **102** proceeds to step **4.20**, and writes an additional plurality of record identifiers REC.ID.**001**-REC.ID.N into the download thread THREAD.**001**-THREAD.N.

In the alternative, when the target system **102** determines in step **4.24** that there are no additional record identifiers REC.ID.**001**-REC.ID.N in the one-dimensional stack STACK.**001**-STACK.N, the target system **102** requests access to the software records REC.**001**-REC.N associated with the record identifiers REC.ID.**001**-REC.ID.N in a designated download thread THREAD.**001**-THREAD.N in step **4.30**. In optional step **4.32**, the accessed records REC.**001**-REC.N associated with the record identifiers REC.ID.**001**-REC.ID.N in the designated download thread THREAD.**001**-THREAD.N are written into the target database **102**I in the memory **102**G of the target system **102**. The target system **102** subsequently returns to step **4.08**, wherein it is determined whether one or more record identifiers REC.ID.**001**-REC.ID.N have been received.

Referring now generally to the Figures, and particularly to FIG. **5**, FIG. **5** is a flowchart of an aspect of the invented method whereby the target system **102** accesses record identifiers REC.ID.**001**-REC.ID.N from threads THREAD.**001**-THREAD.N, accesses a plurality of software records REC.**001**-REC.N associated with the record identifiers REC.ID.**001**-REC.ID.N, and writes the records REC.**001**-REC.N associated with the record identifiers REC.ID.**001**-REC.ID.N into a record stack REC.STACK.**001**-REC.STACK.N in the memory **102**G of the target computing system **102**.

In optional step **5.02** the target system **102** optionally assigns one or more time date stamp bounds TDS.**001**-TDS.N for the download thread THREAD.**001**-THREAD.N that the target system **102** will access. In step **5.04** the target system **102** accesses the desired thread THREAD.**001**-THREAD.N, and in step **5.06** the target system **102** accesses the record identifiers REC.ID.**001**-REC.ID.N within the desired thread THREAD.**001**-THREAD.N. In step **5.08** the target system **102** determines whether the record identifiers REC.ID.**001**-REC.ID.N accessed in step **5.06** are associated with software records REC.**001**-REC.N. When the target system **102** determines in step **5.08** that the record identifiers REC.ID.**001**-REC.ID.N accessed in step **5.06** are not associated with software records REC.**001**-REC.N, the target system **102** executes alternate operations in step **5.22**. Alternatively, when the target system **102** determines in step **5.08** that the record identifiers REC.ID.**001**-REC.ID.N accessed in step **5.06** are associated with software records REC.**001**-REC.N, the target system **102** proceeds to step **5.10**.

In step **5.10**, the target system **102** determines whether additional record identifiers REC.ID.**001**-REC.ID.N remain to be accessed. When the target system **102** determines that additional record identifiers REC.ID.**001**-REC.ID.N remain to be accessed, the target system **102** proceeds to step **5.06**, and accesses the additional record identifiers REC.ID.**001**-REC.ID.N. Alternatively, when the target system **102** determines that no additional record identifiers REC.ID.**001**-REC.ID.N are present to be accessed, the target system **102** proceeds to step **5.12**, wherein the target system **102** requests access to the one or more software records REC.**001**-REC.N associated with the accessed record identifiers REC.ID.**001**-REC.ID.N. The target system **102** may preferably and optionally request the one or more software records REC.**001**-REC.N associated with the accessed record identifiers REC.ID.**001**-REC.ID.N from the source system across the network **100**. In step **5.14**, the target system **102** receives the one or more records REC.**001**-REC.N and stores the one or more records REC.**001**-REC.N in the record stack REC.STACK.**001**-REC.STACK.N. In step **5.16**, the target system **102** writes the one or more records REC.**001**-REC.N to the memory **102**G of the target computing system **102**.

In step **5.18** the target system **102** determines whether additional software records REC.**001**-REC.N remain in the record stack REC.STACK.**001**-REC.STACK.N to be transferred to the memory **102**G of the target system **102**. When the target system **102** determines that additional software records REC.**001**-REC.N remain in the record stack REC.STACK.**001**-REC.STACK.N to be transferred to the memory **102**G of the target computing system **102**, the target system **102** proceeds to step **5.14**, and executes the loop of steps **5.14** through **5.18** as necessary.

Alternatively, when the target system **102** determines in step **5.18** that no additional software records REC.**001**-REC.N remain in the record stack REC.STACK.**001**-REC.STACK.N to be transferred to the memory **102**G of the target computing system **102**, the target system **102** proceeds to step **5.20**. In step **5.20** the target system **102** determines whether to terminate the process. When the target system **102** determines not to terminate the process, the target system **102** proceeds to step **5.04** and re-executes the loop of steps **5.04** through **5.20** until a positive determination is achieved in step **5.20**. When the target system **102** determines in step **5.20** to terminate the process, the target system **102** executes alternate operations in step **5.22**.

Referring now generally to the Figures, and particularly to FIG. **6**, FIG. **6** is a flowchart of an aspect of the invented method whereby the source system **104** is queried and accessed for record identifiers REC.ID.**001**-REC.ID.N and software records REC.**001**-REC.N. In step **6.02** the source system **104** determines whether a request for record identifiers REC.ID.**001**-REC.ID.N has been received from the target system **102**. When the source system **104** determines in step **6.02** that a request for record identifiers REC.ID.**001**-REC.ID.N has been received from the target system **102**, the source system **104** transmits the record identifiers REC.ID.**001**-REC.ID.N to the target system **104** in step **6.04**. Alternatively, when the source system **104** determines that no request for record identifiers REC.ID.**001**-REC.ID.N has been received from the target system **102**, the source system **104** proceeds to step **6.06**. In step **6.06**, the source system **104** determines whether a request for software records REC.**001**-REC.N has been received from the target system **102**. When the source system **104** determines in step **6.06** that a request has been received from the target system **102** for software records REC.**001**-REC.N, the source system **104** transmits the software records REC.**001**-REC.N to the target system **102** in step **6.08**. When the source system **104** determines in step **6.06** that no request has been received from the target system **102** for software records REC.**001**-REC.N, the source system **104** executes alternate operations in step **6.12**. In step **6.10** the source system **104** determines whether any outstanding or additional requests are present. When the source system **104** determines that there are outstanding and/or additional requests, the source system **104** re-executes the loop of **6.02** through **6.10**. When the source system **104** determines that no outstanding or additional requests are present, however, the source system **104** executes alternate processes.

Referring now generally to the Figures, and particularly to FIG. **7**A through FIG. **7**D, FIG. **7**A through FIG. **7**D are block diagrams of a first through an Nth exemplary one-dimensional stack STACK.**001**-STACK.N. More particularly, FIG. **7**A and FIG. **7**B show a REC.STACK.**001** and a REC.STACK.N, respectively, each containing an optional record stack identifier, REC.STACK.ID.**001**-REC.STACK-.ID.N, and a first exemplary column of software records REC.**001**-REC.N, and a second exemplary column of software records REC.**502**-REC.N, respectively. FIGS. **7**C and **7**D show software record identifier stacks STACK.**001** and STACK.N, respectively, each containing an optional stack identifier STACK.ID.**001**-STACK.ID.N, and a first column of software record identifiers REC.ID.**001**-REC.ID.N, and a second column of software record identifiers REC.ID.**378**-REC.ID.N, respectively.

Referring now generally to the Figures, and particularly to FIG. **7**E through FIG. **7**H, FIG. **7**E through FIG. **7**H are block diagrams of an exemplary first through Nth two-dimensional record stack REC.STACK**2**.**001**-REC.STACK**2**.N and an exemplary first through Nth two-dimensional stack STACK**2**-**001**-STACK**2**.N. The exemplary first two-dimensional record stack REC-.STACK**2**.**001** of FIG. **7**E comprises an optional first two-dimensional record stack identifier REC.STACK**2**.ID.**001**, exemplary first and second record row REC.RW.**001**-REC.RW.**002**, and an exemplary first plurality of records REC.**001**-REC.**005** contained within the first row REC.RW.**001** of the exemplary first two-dimensional record stack REC.STACK**2**.**001**, and an additional plurality of records REC.**006**-REC.N contained within the second row REC.RW.**003** of the exemplary first two-dimensional record stack REC.STACK**2**.**001**.

The exemplary Nth two-dimensional record stack REC.STACK**2**.N of FIG. **7**F comprises an optional Nth

two-dimensional record stack identifier REC.STACK**2**.ID.N, exemplary third and Nth record row REC.RW.**003**-REC.RW.N, and an exemplary plurality of records REC.**503**-REC.**507** contained within the third record row REC.RW.**001**, and an additional exemplary plurality of records REC.**508**-REC.N contained within the Nth record row REC.RW.N. It is understood that that the numerals assigned to exemplary software records REC.**001**-REC.N, and the number of shown software records REC.**001**-REC.N have been chosen for illustrative purposes only, and are not intended to act as a limitation upon the number or type of software record REC.**001**-REC.N which may be contained within the exemplary first and Nth two-dimensional record stacks REC.STACK**2**.**001**-REC.STACK**2**.N. It is additionally understood that the software records REC.**001**-REC.N stored within the record rows REC.RW.**001**-REC.RW.N of the two-dimensional record stacks REC.STACK**2**.**001**-REC.STACK**2**.N may, need not necessarily, have consecutive numeral assignments, but have been labeled with consecutive numerals in the Figures only to facilitate explanation and understanding.

The exemplary first two-dimensional stack STACK**2**.**001** of FIG. **7**G comprises an optional first two-dimensional stack identifier STACK**2**.ID.**001**, exemplary first and second rows RW.**001**-RW.**2**, and an exemplary plurality of record identifiers REC.ID.**001**-REC.ID.**005** contained within the first row RW.**001**, and an additional exemplary plurality of record identifiers REC.ID.**006**-REC.ID.N contained within the first row RW.**002**. The exemplary Nth two-dimensional stack STACK**2**.N of FIG. **7**H comprises an optional Nth two-dimensional stack identifier STACK**2**.ID.N, exemplary third and Nth row RW.**003**-RW.N, and a third exemplary plurality of record identifiers REC.ID.**379**-REC.ID.**383** in the third row RW.**003** of the Nth two-dimensional stack STACK**2**.N, and an Nth exemplary plurality of record identifiers REC.ID.**384**-REC.ID.N in the Nth row RW.N of the Nth two-dimensional stack STACK**2**.N. It is understood that that the numerals assigned to exemplary software records identifiers REC.ID.**001**-REC.ID.N, and the number of shown software records identifiers REC.ID.**001**-REC.ID.N have been chosen for illustrative purposes only, and are not intended to act as a limitation upon the number or type of software record REC.**001**-REC.N which may be contained within the exemplary first and Nth two-dimensional stacks STACK**2**.**001**-STACK**2**.N. It is additionally understood that the software record identifiers REC.ID.**001**-REC.ID.N stored within the rows RW.**001**-RW.N of the two-dimensional stacks STACK**2**.**001**-STACK**2**.N may, but need not necessarily, have consecutive numeral assignments, but have been labeled with consecutive numerals in the Figures only to facilitate explanation and understanding.

Referring now generally to the Figures, and particularly to FIG. **8**A through FIG. **8**D, FIG. **8**A through FIG. **8**D are block diagrams of a first through an Nth exemplary software record REC.**001**-REC.N. The first exemplary software record REC.**001** contains a first record identifier REC.ID.**001**, a first time date stamp TDS.**001**, and a first plurality of record data DATA.**001**. The exemplary software records REC.**002**-REC.N contain, respectively, exemplary second through Nth record identifiers REC.**002**-REC.N, exemplary time date stamps TDS.**002**-TDS.N, and exemplary pluralities of record data DATA.**002**-DATA.N.

Referring now generally to the Figures, and particularly to FIG. **9**A through FIG. **9**D, FIG. **9**A through FIG. **9**D are block diagrams of a first through an Nth exemplary thread THREAD.**001**-THREAD.N. The first exemplary thread THREAD.**001** contains a first thread identifier

THREAD.ID.**001**, a first time date stamp datum TDS-.DATA.**001**, and a plurality of software record identifiers REC.ID.**001**-REC.ID.N. The second through Nth exemplary threads THREAD.**002**-THREAD.N contain, respectively, a second through Nth thread identifier THREAD.ID.**002**-THREAD.ID.N, a second through Nth time date stamp datum TDS.DATA.**002**-TDS.DATA.N, and a plurality of software record identifiers REC.ID.**001**-REC.ID.N

The foregoing description of the embodiments of the invention has been presented for the purpose of illustration; it is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Persons skilled in the relevant art can appreciate that many modifications and variations are possible in light of the above disclosure.

Referring now generally to the Figures, and particularly to FIG. **10**A, FIG. **10**A is a block diagram of an exemplary first record identifiers REC.ID.**001**-REC.ID.N containing message MSG.**001** (hereinafter "first message MSG.**001**") transmitted from the source system **104** to the target system **102**. The first message MSG.**001** comprises: a first message identifier MSG.ID.**002**, by which the first message MSG.**001** maybe recognized; a first message time date stamp MSG.TDS.**002**, indicating the time point at which the first message MSG.**001** was transmitted from the source system **104**; an address SRC.ADDR of the source system **104** as the sending address of the first message MSG.**001**; an address TGT.ADDR of the target system **102** as the receiving address of the first message MSG.**001**; and a plurality of record identifiers REC.ID.**001**-REC.ID.N.

Referring now generally to the Figures, and particularly to FIG. **10**B, FIG. **10**B is a block diagram of an exemplary second message MSG.**002** (hereinafter "second message MSG.**002**") transmitted from the target system **102** to the source server **104**. The second message MSG.**002** comprises: a second message identifier MSG.ID.**003**, by which the second message MSG.**002** may be recognized; a second message time date stamp MSG.TDS.**003**, indicating the time point at which the second message MSG.**002** was transmitted from the target system **102**; an address TGT.ADDR of the target system **102** as the sending address of the second message MSG.**002**; an address SRC.ADDR of the source server **104** as the receiving address of the second message MSG.**002**; and set of time date stamp boundaries TDS BOUNDS for a query to the source server **104**.

Referring now generally to the Figures, and particularly to FIG. **10**C, FIG. **10**C is a block diagram of an exemplary third software record REC.**001**-REC.N containing message MSG.**003** (hereinafter "third message MSG.**003**") transmitted from the source system **104** to the target system **102**. The third message MSG.**003** comprises: a third message identifier MSG.ID.**002**, by which the third message MSG.**003** maybe recognized; a third message time date stamp MSG.TDS.**002**, indicating the time point at which the third message MSG.**003** was transmitted from the source system **104**; an address SRC.ADDR of the source system **104** as the sending address of the third message MSG.**003**; an address TGT.ADDR of the target system **102** as the receiving address of the third message MSG.**003**; and a plurality of software records REC.**001**-REC.N.

Some portions of this description describe the embodiments of the invention in terms of algorithms and symbolic representations of operations on information. These algorithmic descriptions and representations are commonly used by those skilled in the data processing arts to convey the substance of their work effectively to others skilled in the art. These operations, while described functionally, computationally, or logically, are understood to be implemented by

computer programs or equivalent electrical circuits, microcode, or the like. Furthermore, it has also proven convenient at times, to refer to these arrangements of operations as modules, without loss of generality. The described operations and their associated modules may be embodied in software, firmware, hardware, or any combinations thereof.

Any of the steps, operations, or processes described herein may be performed or implemented with one or more hardware or software modules, alone or in combination with other devices. In one embodiment, a software module is implemented with a computer program product comprising a non-transitory computer-readable medium containing computer program code, which can be executed by a computer processor for performing any or all of the steps, operations, or processes described.

Embodiments of the invention may also relate to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, and/or it may comprise a general-purpose computing device selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a non-transitory, tangible computer readable storage medium, or any type of media suitable for storing electronic instructions, which may be coupled to a computer system bus. Furthermore, any computing systems referred to in the specification may include a single processor or may be architectures employing multiple processor designs for increased computing capability.

Embodiments of the invention may also relate to a product that is produced by a computing process described herein. Such a product may comprise information resulting from a computing process, where the information is stored on a non-transitory, tangible computer readable storage medium and may include any embodiment of a computer program product or other data combination described herein.

Finally, the language used in the specification has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the inventive subject matter. It is therefore intended that the scope of the invention be limited not by this detailed description, but rather by any claims that issue on an application based herein. Accordingly, the disclosure of the embodiments of the invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

What is claimed is:

1. A computer-implemented method comprising:

a. In a target system, accessing a plurality of record identifiers received from an external source database;

b. Storing the plurality of record identifiers in an electronic memory ("memory") of the target system as elements of a software stack ("stack");

c. Reading a first plurality of the plurality of record identifiers ("first plurality") from the stack and into a first thread, whereby the first plurality is thereupon excluded from the stack;

d. Applying the first thread to retrieve from the source database each record associated with each record identifier of the first plurality; and

e. Asynchronous writing of newly accessed additional record identifiers contemporaneously with sequentially writing of record identifiers from the stack into a plurality of threads, wherein each thread of the plurality of threads applies each received record identifier to retrieve from the source database each record associated with each received record identifier.

2. The computer-implemented method of claim **1**, wherein the stack is a one dimensional stack.

3. The computer-implemented method of claim **1**, wherein the stack comprises at least two dimensions and the first plurality is stored in the memory in a row of the stack.

4. The computer-implemented method of claim **1**, further comprising requesting the first plurality from a first set of record identifiers associated with a plurality of records contained within a multiplicity of records.

5. The computer-implemented method of claim **1**, further comprising requesting the plurality of record identifiers in accordance with a date-time range of record updates of the multiplicity of records.

6. The computer-implemented method of claim **1**, further comprising the first thread operating to read at least one accessed record associated with the first plurality.

7. The computer-implemented method of claim **6**, further comprising the first thread operating to write the at least one accessed record associated with the first plurality into a database.

8. The computer-implemented method of claim **6**, further comprising the first thread operating to write the at least one accessed record associated with the first plurality into a one dimensional array.

9. The computer-implemented method of claim **8**, further comprising writing the at least one accessed record from the one dimensional array into a database.

10. The computer-implemented method of claim **1**, wherein the count of record identifiers of the first plurality is a pre-established value.

11. The computer-implemented method of claim **1**, further comprising writing a plurality of records associated with record identifiers of the first plurality into a local database.

12. The computer-implemented method of claim **1**, wherein a maximum count of record identifiers of the first plurality is a pre-established value.

13. The computer-implemented method of claim **1**, wherein the first plurality of record identifiers is written into the first thread when a preset count of record identifiers stored within the stack achieves a pre-established value.

14. The computer-implemented method of claim **13**, wherein a maximum count of record identifiers written into each thread of the plurality of threads is at least partially derived from a thread count value.

15. The computer-implemented method of claim **1**, wherein the first plurality is excluded from the stack after the first plurality is written into the first thread.

16. The computer-implemented method of claim **1**, wherein a preset limit of threads is configurable.

17. The computer-implemented method of claim **1**, wherein a preset limit of record retriever threads is configurable by a user of the target system.

18. The computer-implemented method of claim **1**, wherein a preset limit of record retriever threads is recorded in a software element of the target system.

19. A computer-implemented method comprising:

a. In a target system, accessing a plurality of record identifiers received from an external source database;

b. Storing the plurality of record identifiers in an electronic memory ("memory") of the target system as elements of a software stack ("stack");

c. Reading a first plurality of the plurality of record identifiers ("first plurality") from the stack and into a first record retriever thread, whereby the first plurality is thereupon excluded from the stack;

d. Reading additional pluralities of record identifiers ("second plurality") from the stack and an additional record retriever thread, whereby each record identifier is thereupon excluded from the stack upon reading by any record retriever thread, wherein a process of adding a plurality of record retriever threads continues until a pre-set limit of record retriever threads is reached;

e. Applying each record retriever thread to retrieve each identified record and writing each retrieved record into a record stack until there are no more record identifiers to read and the record identifier stack is empty; and

f. Writing each retrieved record from the record stack into a database accessible to the target system.

20. The computer-implemented method of claim **19**, further comprising retrieving each identified record from a remotely stored database.

21. The computer-implemented method of claim **20**, further comprising requesting each identified record in relation to a time date range of records associated with an alternate plurality of records contained within a multiplicity of records.

22. The computer-implemented method of claim **19**, wherein the preset limit of record retriever threads is configurable.

23. The computer-implemented method of claim **19**, wherein the preset limit of record retriever threads is configurable by a user of the target system.

24. The computer-implemented method of claim **19**, wherein the preset limit of record retriever threads is recorded in a software element of the target system.

25. A system, the system bi-directionally communicatively coupled with an external data source, the system comprising:

a memory;

a processor bi-directionally communicatively coupled with both the memory and the external data source, and the memory is configured to store instructions that, when executed by the processor, cause the system to:

access a plurality of record identifiers received from the external data source;

store the plurality of record identifiers in the memory in a two dimensional stack;

write a first plurality of the plurality of record identifiers ("first plurality") from the stack and into a first record retriever thread, whereby the first plurality is excluded from the stack;

apply the first record retriever thread to enable accessing each record associated with each record identifier of the first plurality;

read additional pluralities of record identifiers from the stack and into at least one record retriever thread of a plurality of record retriever threads, whereby each record identifier is thereupon excluded from the stack upon retrieval by any record retriever thread, wherein a process of adding the plurality of record retriever threads continues until a preset limit of record retriever threads is reached;

apply each record retriever reader thread to retrieve each identified record and write each retrieved record into a record stack until there are no more record identifiers to read and the record identifier stack is empty; and

write each retrieved record from the record stack into a database accessible to the target system.

26. The system of claim **25**, wherein the processor is further adapted to read at least one accessed record associated with the first plurality.

27. The system of claim **26**, wherein the processor is further adapted to write the at least one accessed record associated with the first plurality into a database stored within the memory.

28. The system of claim **27**, wherein the processor is further adapted to write the at least one accessed record associated with the first plurality into a one dimensional array stored within the memory.

29. The system of claim **28**, wherein the processor is further adapted to write the at least one accessed record from the one dimensional array into a database stored within the memory.

30. The system of claim **25**, wherein the stack is a one-dimensional stack.

31. The system of claim **25**, wherein the stack comprises at least two dimensions and the first plurality is stored in a row of the stack.

32. The system claim **25**, wherein the preset limit of record retriever threads is configurable.

33. The system of claim **25**, wherein the preset limit of record retriever threads is configurable by a user of the target system.

34. The system of claim **25**, wherein the preset limit of record retriever threads is recorded as a software encoded value in the memory.

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